(12) UK Patent Application (19) GB (11) 2 181 785 (13) A

(43) Application published 29 Apr 1987

(21) Application No 8525831

(22) Date of filing 19 Oct 1985

(51) INT.CL⁴
F04D 29/62 29/42

(52) Domestic classification (Edition I)
F1C 104 FJ

(56) Documents cited
None

(58) Field of search
F1C
Selected US specifications from IPC sub-class F04D

(71) Applicant
Proizvodstvennoe Obiedinenie "Nevsky Zavod" Imeni V.I. Lenina

(Incorporated in USSR),

prospekt Obukhovskoi oborony 51, Leningrad, Union of Soviet Socialist Republics

(72) Inventors
Vladimir Viktorovich Arkhipov,
Gennady Fedorovich Velikanov,
Jury Sergeevich Gontar,
Viktor Leonidovich Evlannikov,
Vladislav Mikhailovich Kamenev,
Boris Fedorovich Kosarotov,
Sergei Semenovich Lomonosov,
Oleg Dmitrievich Rostovtsev

(74) Agent and/or Address for Service
Mathisen Macara & Co., The Coach House, 6—8 Swakeleys Road, Ickenham, Uxbridge UB10 8BZ

(54) **Centrifugal compressor**

(57) The compressor comprises a housing 1 including a cover 6 positioned at the side of the housing adjacent an outlet chamber 3, and compression stages including diffusers 12, 13, a flow straightener 14 and diaphragms 15—18 of which the diaphragm 18 is connected to the cover and is flexible. Labyrinth seals 26—30 are also provided. To assemble the compressor, the shaft inserted in the cover 6 is positioned vertically and the impeller 21 is mounted on the shaft. Then the members 12—17 and the impeller 20 are mounted on the shaft before the compressor is turned to a horizontal position and installed in the housing 1. The resilience of the diaphragm 18 applies compressive forces to the assembled compressor to compensate deformations of the compressor due to temperature changes.

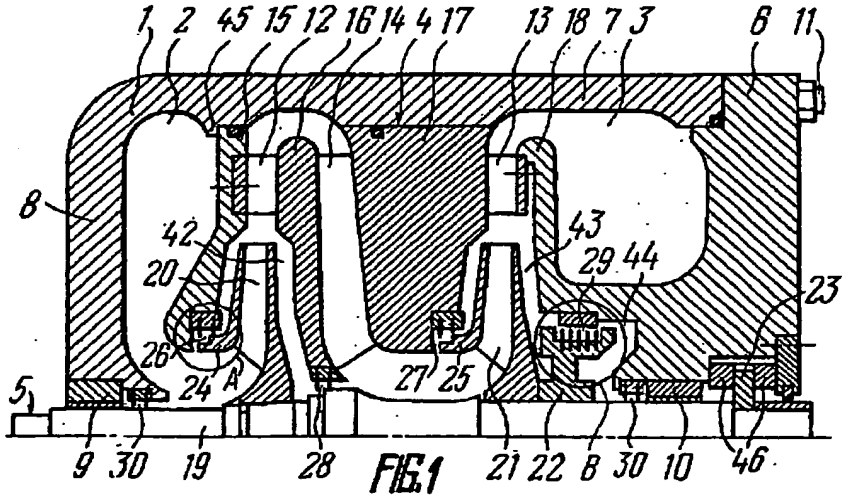

FIG.1

GB 2 181 785 A

2181785

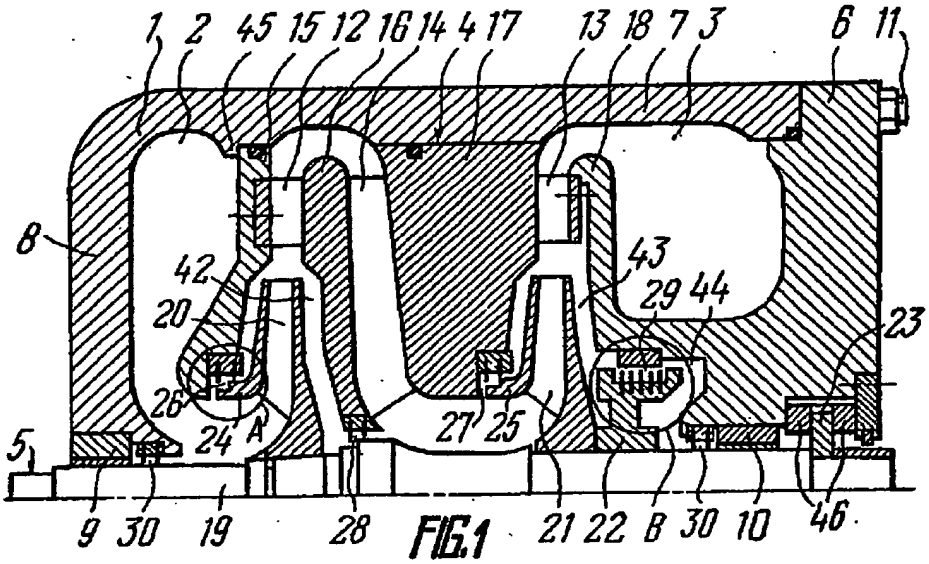

FIG.1

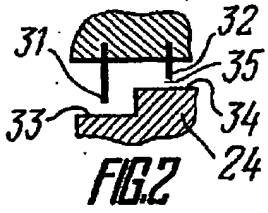

FIG.2

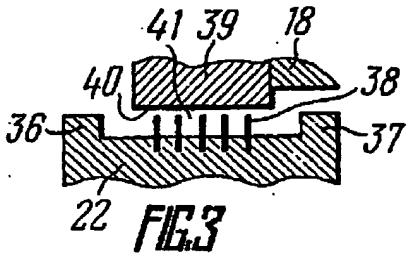

FIG.3

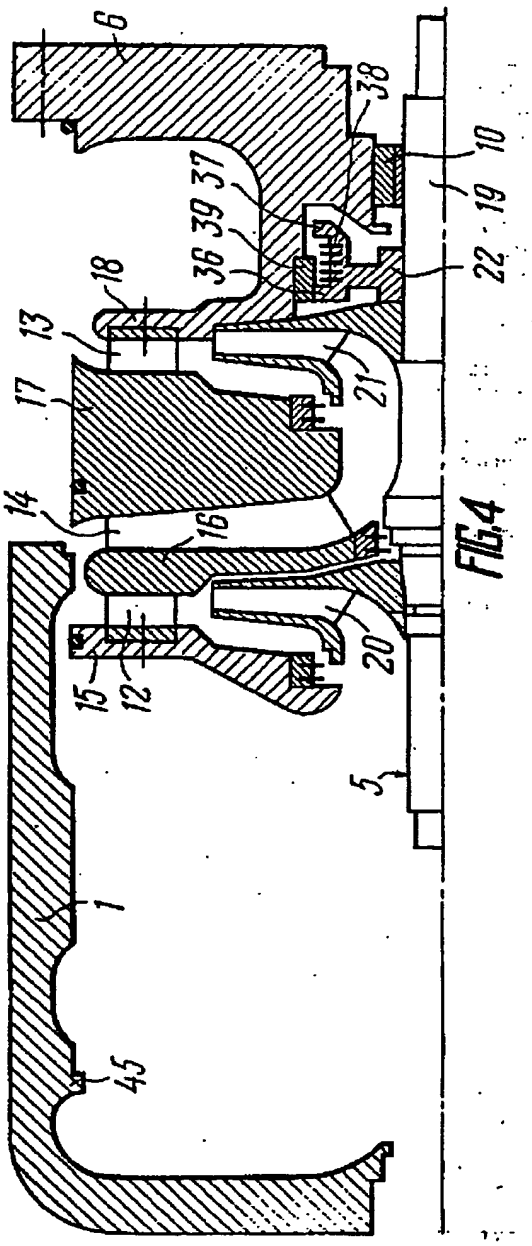

FIG.4

SPECIFICATION

Centrifugal Compressor

This invention relates to compressor construction, and more particularly to centrifugal compressors.

The present invention is directed toward the provision of a compressor in which the cover plate and adjacent diaphragm would be so constructed as to simplify compressor assembly and ensure higher reliability of the compressor in operation.

The aim of the invention is attained by that in a centrifugal compressor a housing of which enclosed at one end by a cover plate and having inlet and outlet chambers accommodates at least one compression stage comprising a pack of rigidly interconnected stationary elements including diaphragms, a diffuser, and a reverse flow straightener, and a rotor, according to the invention, the cover plate is secured to the housing at the side of the outlet chamber, whereas the diaphragm of the pack of stationary elements adjacent the cover plate is resilient and is rigidly connected thereto.

Preferably, one diaphragm of the pack of stationary elements bears axially on the housing.

The invention will now be described in greater detail with reference to a preferred embodiment thereof taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a sectional view of a double-stage centrifugal compressor;

Fig. 2 shows the unit A of Fig. 1 on an enlarged scale;

Fig. 3 is an enlarged view of the unit B in Fig. 1; and

Fig. 4 illustrates a point in the procedure of installing the pack of stationary elements with a rotor and a cover plate in the housing of the compressor.

Described hereinbelow is a specific embodiment of the present invention.

With reference to Fig. 1 of the accompanying drawings, there is shown a double-stage centrifugal compressor comprising a housing 1 having an inlet chamber 2 and an outlet chamber 3, the housing accommodating a pack 4 of stationary elements and a rotor 5. The housing 1 is enclosed by a cover 6 on the side of the outlet chamber 3. The housing 1 is defined by a cylindrical portion 7 and an end wall 8 moulded as one unit. The end wall 8 is adjacent to the inlet chamber 2 and has a support bearing 9 secured therein.

A second support bearing 10 is secured in the cover 6. This cover 6 is connected to the housing 1 by pins 11 arranged equidistantly about the circumference of the cover 6.

The pack 4 of stationary elements comprises diffusers 12, 13, a reverse flow straightener 14, and diaphragms 15, 16, 17 and 18. All aforedescribed elements of the pack 4 are rigidly interconnected into a single assembly by any known suitable means. The diaphragm 18 adjacent the cover 3 is rigidly affixed thereto. In the embodiment being disclosed this diaphragm 18 is made integral with the cover 6 of the housing 1 such as by welding.

The diaphragm 18 is rigidly connected to the diffuser 13 about its outer diameter for the diaphragm 18 to be in contact with the diffuser 13. The diaphragm 18 is connected to the cover 6 of the housing 1 in proximity to the inner diameter thereof.

As a result of such a connection, the diaphragm 18 forms a continuous annular plate functioning as axially pliable damper.

The rotor 5 comprises a shaft 19 on which there are mounted impellers 20 and 21, a dummy 22, and a thrust disk 23. The impeller 20 has a conical fit with the shaft 19 to ensure easy mounting and dismounting. The impellers 20 and 21 are provided with cover disks 24 and 25, respectively.

The centrifugal compressor further comprises labyrinth seals 26 and 27 of the cover disks, an intermediate labyrinth 28 of a shaft 19, a labyrinth seal 29 of the dummy 22, and end labyrinth seals 30 of the shaft 19. The labyrinth seals 26, 27 and 28 are structurally identical and are formed by strips 31 and 32 (Fig. 2) secured on the diaphragm 15 (16, 17) and cylindrical surfaces 33 and 34 on the cover disk 24 (as well as on disk 25 and shaft 19). The cylindrical surfaces 33 and 34 have different diameters. The strips 31 and 32 define with these cylindrical surfaces a small radial clearance 35 ensuring the functioning of the labyrinth seals 26 (Fig. 1), 27 and 28. The radius of the surface 33 is less than the radius of the surface 34, and therefore the labyrinth seals 26, 27, 28 are stepped with the diameters of the steps on the decrease toward the inlet chamber 2 of the housing 1.

The dummy 22 is arranged on the side of the outlet chamber 3 of the housing 1. The dummy 22 has assembly flanges 36 (Fig. 3) and 37, and strips 38 of the labyrinth seal 29 (Fig. 1). A dummy ring 39 is provided in the diaphragm 18, this dummy ring having a substantially cylindrical surface 40 (Fig. 3) with which the strips 38 form a small radial clearance 41 to ensure that the labyrinth seal 29 can function.

The difference between the radii of the flanges 36, 37, and the radius of the cylindrical surface 40 is less than a radial clearance 41 between the ring 39 and the outer diameter of the strips 38 to ensure that the strips 38 are not damaged when assembling the compressor. With reference to Fig. 1, provided between the impeller 20 and diaphragm 18, between the impeller 21 and the diaphragm 18, as well as between the dummy 22 and the cover 6 of the housing are clearances 42, 43 and 44, respectively. For simplifying assembly the clearance 43 should preferably be less than the clearances 42 and 44, whereas the distance from any strips 31 (Fig. 2) and 32 as measured toward the inlet chamber 2 to the edge of the respective surface 33 or 34 with which the strips 31 or 32 form the small radial clearance 35 is less than the axial clearance 43 (Fig. 1).

The diaphragm 15 of the pack 4 of stationary elements bears axially on a projection 45 of the housing 1. Other alternative forms of the diaphragm 15 bearing on the housing 1 are possible; for example, the diaphragm 15 can bear axially on the end wall 8 of the housing 1. Accordingly, the whole pack 4 of stationary elements bears on the housing 1

and all these elements are subjected exclusively to compression stresses. The compressor also has a thrust bearing 46 to prevent the rotor 5 from axial displacement.

The centrifugal compressor embodying the present invention is assembled in the following manner.

With reference to Fig. 4, the support bearing 10 and dummy ring 39 are fitted into the cover 6. Thereafter, inserted vertically to the cover 6 made integral with the diaphragm 18 is the shaft 19 having the impeller 21 and dummy 22 mounted thereon until the impeller 21 is brought in contact with the diaphragm 18. Therewith, the shaft 19 slides axially in the bearing 10, while the flange 37 of the dummy 22 slides in the dummy ring 39. The flange 37 prevents the strips 38 from being damaged. When the impeller 21 is brought in contact with the diaphragm 18, the flange 37 is out of the dummy ring 39, whereas the flange 36 enters the dummy ring 39.

Subsequently, with the vertically positioned shaft 19 the previously rigidly-interconnected diffuser 13, diaphragm 17, reverse flow straightener 14, diaphragm 16 and diffuser 12 are fixedly attached to the diaphragm 18. The impeller 20 is then fitted onto the shaft 19, and the diaphragm 15 is to be secured rigidly to the diffuser 12. Such a procedure obviates almost entirely the possibility of the strips 31 and 32 being damaged by the surfaces 33 and 34, since the distance from any of the strips 31 or 32 measured axially toward the inlet chamber 2 to the edge of the corresponding surface 33 or 34 with which the strips 31 or 32 form the small radial clearance is less than the axial clearance 43.

The thus assembled unit is then turned over to the horizontal position as seen best in Fig. 4, and subsequent assembly procedures are carried out horizontally. In the horizontal position of the pack 4 of stationary elements united with the cover 6 of the housing 1, the rotor 5 bears on the ring 39 by the flange 37, and on the bearing 10 by the shaft 19.

The pack 4 of stationary elements with the cover 6 and rotor 5 assembled are installed inside the housing 1.

The diaphragm 15 of the pack 4 of stationary elements bears axially on the projection 45 of the housing 1. After attaching the cover 6 to the housing 1 by the pins 11, the support bearing 9 is mounted in the housing 1, and the rotor 5 is set in a working position in which the surfaces 33 occupy a space under the strips 31, whereas the surfaces 34 occupy a space under the strips 32 to form the radial clearance 35 which ensures that the labyrinth seals 26, 27 and 28 can function.

The assembly flange 36 is then brought out of the dummy ring 39. Thereafter, the labyrinth seals 30 and the thrust disk 23 are assembled to be followed by setting the rotor 5 in the working position by mounting the thrust bearing 46.

A difference in the length of the pack 4 of stationary elements in assembly with the cover 6 prior to and after mounting of the pack in the housing 1, and the axial resilient deformation of the diaphragm 18 ensure that the elements of the pack 4 are subjected to the action of exclusively compression forces and that temperature deformation of the stationary elements caused by compressor operation are compensated.

Because the diaphragm 15 and therefore the entire pack 4 of stationary elements bear on the projection 45 of the housing 1, the difference in the pressure of gas in the outlet chamber 3 and inlet chamber 2 causes the appearance in the elements of the pack 4 of only axial compression stresses, thanks to which the fastening means rigidly connecting the elements of the pack 4 can be light-weight and are not subject to tensile stress to result in their higher reliability in operation.

CLAIMS

1. A centrifugal compressor a housing of which enclosed at one side by a cover and having inlet and outlet chambers accommodates at least one compression stage including a pack of stationary elements comprising diaphragms, a diffuser, and a reverse flow straightener all rigidly interconnected therebetween, and a rotor; the cover being secured to the housing at the side of the outlet chamber; the diaphragm of the pack of stationary elements adjacent the cover being pliable and is rigidly connected to the cover.

2. A centrifugal compressor as claimed in claim 1, in which one of the diaphragms of the pack of stationary elements bears axially on the housing.

3. A centrifugal compressor substantially as described in the description with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by Courier Press, Leamington Spa, 4/1987. Demand No. 8991685.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.